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# SEASONAL OCCURRENCE OF MARINE FISHES IN FOUR SHORES HABITATS NEAR BEAUFORT, N. C., 1957-60

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United States Department of the Interior, Stewart L. Udall, Secretary
Fish and Wildlife Service, Clarence F. Pautzke, Commissioner
Bureau of Commercial Fisheries, Donald L. McKernan, Director

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# SEASONAL OCCURRENCE OF MARINE FISHES IN FOUR SHORE HABITATS NEAR BEAUFORT, N. C., 1957-60

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## ABSTRACT

Monthly frequency of occurrence and size range of marine fishes in four shore habitats in the vicinity of Beaufort, N. C., were determined by a 3-year seining program. The largest number of fish was collected during spring, and the least number was obtained during winter. Most species occurred during summer and fall. Collections contained 65 species representing 34 families.

## INTRODUCTION

Marine fishes of North Carolina and specifically those of Beaufort have been reviewed by various investigators over the past 80 years. Fishes of North Carolina were treated in a descriptive catalog compiled by Smith (1907). Salt and brackish water species recorded from the State since the publication of Smith's work were listed by Hildebrand (1941). Fowler (1945) reported on the occurrence of fishes in North Carolina in a study of fishes of the southern Piedmont and Coastal Plain. Buller (1951) listed fishes obtained by trawl in a fishery survey off the coasts of Virginia, North Carolina, and South Carolina. Fishes of Beaufort, N. C., were dealt with in early catalogs compiled by Yarrow (1877) and by Jordan and Gilbert (1879). Subsequent contributions were made by Jordan (1886), Jenkins (1887), Linton (1905), Coles (1910), Gudger (1910, 1912a, 1912b, 1913a, and 1913b), and Radcliffe (1916). Hildebrand and Cable (1930 and 1938) studied the development and life history of some teleostean fishes at Beaufort. Fishes of the Neuse River (near Beaufort) were treated in an annotated list of 55 recorded species compiled by Evermann and Cox (1896). The present study is a report on a 3-year seining program (March 1957-February 1960) which was conducted to determine monthly frequency of occurrence and size range of salt and brackish water fishes in the inshore waters of the Beaufort area.

The authors wish to thank Dr. Earl E. Deubler, Jr., University of North Carolina Institute of Fisheries Research, Morehead City, N. C., for his aid in identification of certain fishes and review of manuscript.

## DESCRIPTION OF COLLECTING STATIONS

Four stations which represented different ecological situations were

Note.--Marlin E. Tagatz, *Fishery Research Biologist*, and Donnie L. Dudley, *Fishery Technician*.

selected in shore zone areas in the vicinity of Beaufort. Stations were assigned numbers from 1 to 4 according to decreasing salinity (fig. 1). These are described as follows:

Station 1 was located on the ocean side of Bogue Banks, approximately 2 miles west of Atlantic Beach, N. C. These banks extended east and west and were separated from the mainland by Bogue Sound. The bottom had a gradual slope; the inshore portion consisted of fine sand and shell fragments, and the offshore portion consisted almost entirely of sand. Time of sampling was irrelevant to tidal stage. Salinity ranged from 24.9 to 37.8 ‰.

Station 2 was located on the west shore of Pivers Island in Beaufort Harbor. This station was selected to include salt marsh which was covered mainly with *Spartina alterniflora*. The bottom was fine sand, with little slope. It was seined at high flood tide to include the marsh and sand flat which were exposed at low tide. Salinity ranged from 22.0 to 37.0 ‰.

Station 3 was located on the Neuse River one-half mile below Great Island and approximately 20 miles upriver from the mouth. The seining area was within a large, cove-like indentation of the shoreline. The bottom had a gradual slope and consisted of sand and clay. The area was free of aquatic vegetation, but scattered stumps and debris were present. This location was characterized by fluctuating water levels caused by watershed drainage, wind, and tide. Salinity ranged from 0 to 22.3 ‰.

Station 4 was located on the Neuse River $1\frac{1}{2}$ miles south of New Bern,

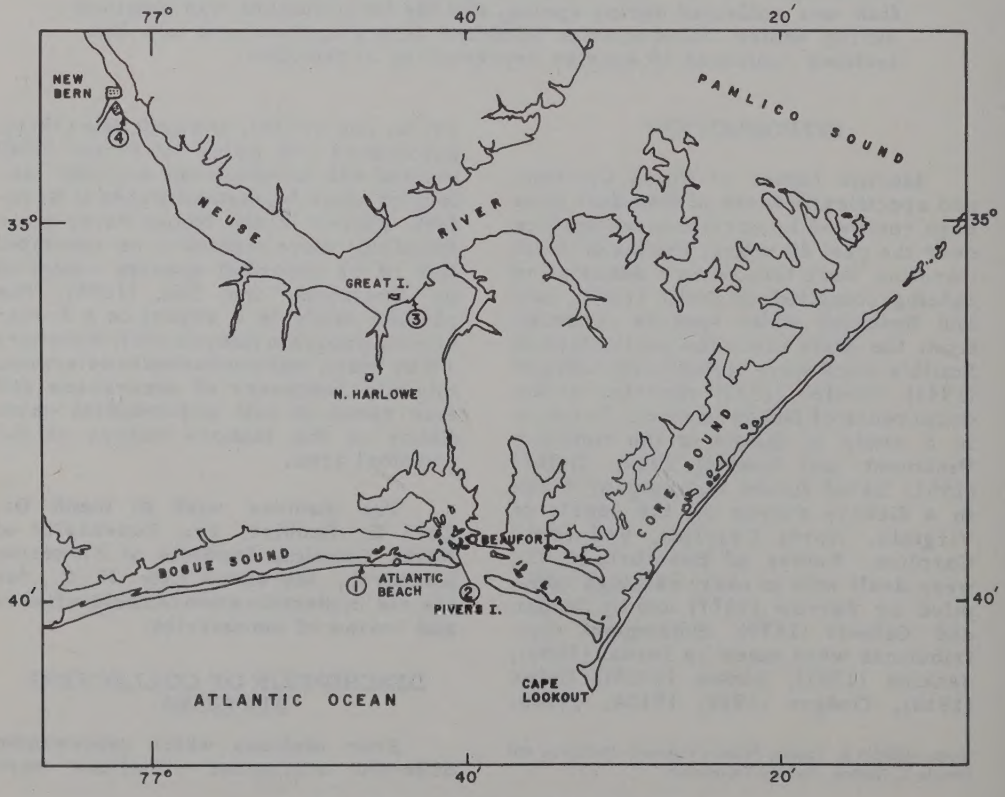


Figure 1.--Location of the four collecting stations.

N. C., and approximately 19 miles north of station 3. The bottom had little slope, was free of vegetation and debris, and consisted of coarse sand. Water levels remained relatively constant. Salinity was usually 0 ‰, and the highest recorded was 5.6 ‰.

## MATERIALS AND METHODS

From March 1957 through February 1960, sampling was conducted during daylight hours at stations 1, 2, and 3 at 2-week intervals, and at station 4 at 4-week intervals. A nylon haul sein, 70 feet long, 5 feet deep, with a funnel-shaped bag 15 feet long was used. The wings of the seine were 3/8-inch stretched mesh and the bag 5/32-inch stretched mesh. Seining was conducted about 20 feet from the shoreline in 3 to 5 feet of water. A sample consisted of the fish caught in three hauls, each haul was approximately 50 feet in length. Each haul was made parallel to the shore and completed by pulling to shore. Seining was advanced about 50 feet after each haul to avoid areas seined previously. Salinity in parts per thousand (hydrometer reading corrected for temperature) and surface water temperature in degrees centigrade were obtained at each station.

Fish were placed in labelled jars and preserved in 10 percent formalin for later examination. Specimens in each sample were identified, and the number and size range of each species determined. Lengths of specimens possessing forked tails were measured from the tip of the snout to caudal fork. Those with nonforked tails were measured from the tip of the snout to the tip of the longest caudal ray. References used for identification were Bigelow and Schroeder (1953), Breder (1929), Deubler (1958), Hildebrand and Cable (1930, 1934, 1938), Hildebrand and Schroeder (1928), Jordan and Evermann (1896-1900), and Smith (1907). Nomenclature followed that of Bailey, et al. (1960).

Specimens representing the size distribution of each species collected were donated to the University of North Carolina Institute of Fisheries Research, Morehead City, N. C., for cataloging and inclusion in their collection of fishes.

## SPECIES COMPOSITION AND SEASONAL OCCURRENCE

The collections obtained totaled 211,994 marine fish, consisting of 65 species, 34 families, and 11 orders. The number of each species collected by station, and salinity and temperature ranges at capture are presented in table 1. Numerically predominant at station 1 were Atlantic menhaden *(Brevoortia tyrannus)*, striped anchovy *(Anchoa hepsetus)*, and rough silverside *(Membras martinica)*; at station 2--Atlantic menhaden, spot *(Leiostomus xanthurus)*, and Atlantic silverside *(Menidia menidia)*; at station 3--bay anchovy *(Anchoa mitchilli)*, spot, and Atlantic silverside; and at station 4--Atlantic menhaden, bay anchovy, and tidewater silverside *(Menidia beryllina)*. Twenty-four species occurred at three or more stations, and 19 species collected at station 3 were not found at station 4. Many species showed tolerance to wide ranges in salinity and temperature, especially the Atlantic silverside which was collected in waters ranging from 0 to 37.8 ‰ and 1.5° to 32.0° C. The striped anchovy, striped killifish *(Fundulus majalis)*, rough silverside, and five species of flounder were collected primarily in waters of high salinity (stations 1 and 2) whereas the bay anchovy, mummichog *(Fundulus heteroclitus)*, tidewater silverside, and southern flounder *(Paralichthys lethostigma)* were most abundant in waters of low salinity (stations 3 and 4).

Monthly occurrence of marine fishes and range in length (mm.) are given for each station in tables 2 through 5. Ranges in water temperature and salinity recorded at each station by month are listed in table 6. Forty species were collected at station 1, 34 species at station 2, 43 species at station 3, and 26 species at station 4. Fishes collected every month of the year from inside waters (stations 2-4) were Atlantic menhaden, bay anchovy, striped killifish, spot, pinfish *(Lagodon rhomboides)*, striped mullet *(Mugil cephalus)*, tidewater silverside,

and Atlantic silverside. Young or immature gulf kingfish *(Menticirrhus littoralis)* were collected at the ocean beach (station 1) every month except February.

Collected at station 4 were 12 species of fresh-water fish that were not included in the analysis of data. The numbers of each species were 13 chain pickerel *(Esox niger)*, 1 carp *(Cyprinus carpio)*, 11 silvery minnow *(Hybognathus nuchalis)*, 4 golden shiner *(Notemigonus crysoleucas)*, 4 satinfin shiner *(Notropis analostanus)*, 122 spottail shiner *(N. hudsonius)*, 1 mimic shiner *(N. volucellus)*, 3 brown bullhead *(Ictalurus nebulosus)*, 2 channel catfish *(I. punctatus)*, 15 banded killifish *(Fundulus diaphanus)*, 2 pumpkinseed *(Lepomis gibbosus)*, and 29 yellow perch *(Perca flavescens)*. One satinfin shiner, 16 banded killifish, and 1 pumpkinseed were also collected at station 3; the first named in water of 19.0 ‰, the second in water of 11.8 ‰, and the third in fresh water.

The seasonal relative abundance of major species (represented in the survey by more than 100 specimens) is presented by station in table 7. During the winter (December-February) pinfish and striped mullet made up 78 percent of the collected specimens at station 1; Atlantic silverside made up 70 percent of the specimens at station 2 and 92 percent at station 3; and tidewater silverside made up 79 percent of the specimens at station 4. During the spring (March-May) 92 percent of the fish collected at station 1 were Atlantic menhaden; 74 percent of the fish collected at station 2 and 70 percent at station 3 were Atlantic menhaden and spot; and 66 percent of the fish collected at station 4 were Atlantic menhaden. During the summer (June-August) 67 percent of the specimens from station 1 were pompano *(Trachinotus carolinus)* and gulf kingfish; 59 percent of the specimens from station 2 and 62 percent from station 3 were spot and Atlantic silverside; and 82 percent of the specimens from station 4 were Atlantic menhaden and bay anchovy. In the fall (September-November), fish collected at station 1 were 70 percent striped anchovy; fish collected at station 2 were 59 percent Atlantic silverside; and fish collected at stations 3 and 4 were 74 and 62 percent respectively, Atlantic menhaden and bay anchovy.

Abundance of fish and number of species in the collections varied between seasons. The least numbers of fish and species were collected in winter when 8,186 individuals (18 species) were obtained. Fish were most abundant in spring when 109,532 specimens (41 species) were collected. Spring yielded the largest catches primarily because of the peak abundance of young Atlantic menhaden, spot, and striped mullet in the collections at each station. The largest number of species, 54, was collected during the summer and totaled 47,138 individuals. The same number of specimens (47,138) was collected during the fall, but fewer species (48) were represented.

## OCCURRENCES OF SPECIAL NOTE

*Elops saurus* — Ladyfish

Nine ladyfishes, 29 to 200 mm. in length, were collected from the Neuse River. At station 3, one was obtained April 29, three on July 11, one on July 26, one on August 26, 1957, and one on July 6, 1959. At station 4, one was obtained April 29 and one on July 24, 1957. No previous record of occurrence of *E. saurus* from the Neuse River was found in the literature. Smith (1907) reported the species not common at Beaufort.

*Lucania parva* — Rainwater killifish

Twelve rainwater killifishes, 23 to 32 mm. in length, were collected at station 3 in the Neuse River on June 11, 1958. Smith (1907) reported no record of occurrence of *L. parva* in North Carolina, but stated it probably occurs in the State; no record was given by Hildebrand (1941). Kuntz (1916) wrote of its presence in Mullet Pond on Shackleford Banks.

*Lutjanus griseus* — Gray snapper

Two gray snappers, 21 and 22 mm. in length, were collected at station 1

on September 18, 1958. Smith (1907) gave the first record and Gudger (1913a) the second record of occurrence of this species on the North Carolina coast.

*Oligoplites saurus* Leatherjacket

Two leatherjackets, 71 and 75 mm. in length, were collected at station 2 in October 1958. One hundred and twenty-eight, 20 to 93 mm. in length, were collected at station 3 from July through October 1957-59; and 47, 28 to 92 mm. in length, were collected at station 4 from July through September 1957. No previous record of occurrence of *O. saurus* from the Neuse River was found in the literature. This river is apparently an important nursery area for this species. Smith (1907) listed a specimen from Beaufort as the first North Carolina record, and Gudger (1913a) listed a specimen from Cape Lookout as the second record.

*Trachinotus falcatus* Permit

Eleven permits, 14 to 47 mm. in length, were collected at stations 1 and 2 during May through October 1957-59, and one, 80 mm. in length, was collected at station 3 on October 15, 1958. Young of this species have been taken at Beaufort and Cape Lookout (Smith, 1907; Gudger, 1913a), but no previous record of occurrence from the Neuse River was found in the literature.

*Sciaenops ocellata* Red drum

Collections from the Neuse River contained 175 red drum, 10 to 85 mm. in length. Taylor (1951) indicated that it was not certain whether red drum spawned off North Carolina or whether the State was getting the results of Chesapeake Bay spawning. Occurrence of these young, especially those as small as 10 mm., suggests spawning off North Carolina. The Neuse River is apparently a nursery area for this species.

*Sphyraena barracuda* Great barracuda

One juvenile great barracuda, 24 mm. in length, was taken at station 1 on September 18, 1958. Breder (1929) refers to *S. barracuda* as "a typical West Indian species regularly reaching South Carolina and straggling rarely to Massachusetts." First reports for North Carolina were three specimens taken at Pivers Island, Beaufort, November 3, 1914, and another at Cape Lookout, August 7, 1915 (Hildebrand, 1941). Fowler (1945) reported one taken off Southport on August 9, 1937.

*Paralichthys squamilentus* Broad flounder

One broad flounder, 161 mm. in length, was collected at station 1 on August 27, 1957. This was the first record of this species in North Carolina (Rothschild and Deubler, 1960). Subsequently, 26 juveniles, 18 to 39 mm. in length, were collected at station 1; 17 on April 28, 1958, 3 on March 31, 1959, and 6 on April 28, 1959.

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TABLE 1.--Marine fishes collected by station, with salinity and temperature ranges at capture, 1957-60

| Species | Station | | | | Salinity | Temperature |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | °/oo | °C. |
| DASYATIDAE - stingrays: | | | | | | |
| *Dasyatis sayi*, bluntnose stingray..... | 1 | - | - | - | 35.8 | 27.7 |
| ELOPIDAE - tarpons: | | | | | | |
| *Elops saurus*, ladyfish..... | - | - | 7 | 2 | 0-17.6 | 24.8-31.2 |
| CLUPEIDAE - herrings: | | | | | | |
| *Alosa aestivalis*, blueback herring..... | 1 | - | 77 | 250 | 0-35.5 | 4.2-29.0 |
| *Alosa pseudoharengus*, alewife..... | - | - | 1 | - | 7.4 | 30.0 |
| *Alosa sapidissima*, American shad..... | - | - | 1 | 47 | 0-5.0 | 15.5-29.5 |
| *Brevoortia tyrannus*, Atlantic menhaden.. | 28,270 | 6,009 | 16,688 | 25,085 | 0-36.0 | 4.2-32.0 |
| *Opisthonema oglinum*, Atlantic thread herring..... | - | 167 | 1 | - | 13.6-34.7 | 24.2-29.0 |
| ENGRAULIDAE - anchovies: | | | | | | |
| *Anchoa hepsetus*, striped anchovy..... | 5,090 | 95 | 39 | 4 | 3.4-35.2 | 16.0-31.2 |
| *Anchoa mitchilli*, bay anchovy..... | 155 | 866 | 16,903 | 7,179 | 0-35.9 | 3.8-31.2 |
| SYNODONTIDAE - lizardfish: | | | | | | |
| *Synodus foetens*, inshore lizardfish..... | - | 20 | - | - | 28.7-46.6 | 18.5-28.8 |
| ANGUILLIDAE - freshwater eels: | | | | | | |
| *Anguilla rostrata*, American eel..... | 7 | 4 | 5 | 5 | 0-33.8 | 8.0-28.2 |
| CONGRIDAE - conger eel: | | | | | | |
| *Conger oceanicus*, conger eel..... | - | 4 | - | - | 22.3-23.8 | 10.3-14.0 |
| BELONIDAE - needlefishes: | | | | | | |
| *Strongylura acus*, agujon..... | - | 32 | - | - | 28.7-36.6 | 17.0-27.8 |
| *Strongylura marina*, Atlantic needlefish. | 1 | 173 | 75 | 20 | 0-37.0 | 15.0-32.0 |
| HEMIRAMPHIDAE - halfbeaks: | | | | | | |
| *Hyporhamphus unifasciatus*, halfbeak..... | 1 | 98 | - | - | 24.5-32.7 | 16.0-24.3 |
| CYPRINODONTIDAE - killifishes: | | | | | | |
| *Cyprinodon variegatus*, sheepshead minnow | - | 16 | 6 | - | 3.7-32.2 | 6.0-29.0 |
| *Fundulus heteroclitus*, mummichog..... | - | 3 | 83 | 60 | 0-31.2 | 13.9-32.0 |
| *Fundulus majalis*, striped killifish..... | 4 | 2,089 | 30 | - | 0-37.0 | 7.1-32.0 |
| *Lucania parva*, rainwater killifish..... | - | - | 12 | - | 0 | 32.0 |

TABLE 1.--Marine fishes collected by station, with salinity and temperature ranges at capture, 1957-60 (continued)

| Species | Station | | | | Salinity | Temperature |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | °/oo | °C. |
| POECILIIDAE - livebearers: | | | | | | |
| *Gambusia affinis*, mosquitofish..... | - | - | 6 | 1 | 0-18.0 | 9.5-27.0 |
| SYNGNATHIDAE - pipefishes and seahorses: | | | | | | |
| *Syngnathus* sp., pipefish..... | 10 | - | 16 | - | 4.0-35.5 | 9.0-31.0 |
| SERRANIDAE - sea basses: | | | | | | |
| *Roccus americanus*, white perch..... | - | - | - | 1 | 0 | 28.2 |
| LUTJANIDAE - snapper: | | | | | | |
| *Lutjanus blackfordi*, red snapper..... | 1 | - | - | - | 35.7 | 27.6 |
| *Lutjanus griseus*, gray snapper..... | 2 | - | - | - | 32.4 | 26.8 |
| POMATOMIDAE - bluefishes: | | | | | | |
| *Pomatomus saltatrix*, bluefish..... | 32 | 1 | 7 | - | 0-37.5 | 15.2-31.2 |
| CARANGIDAE - jacks, scads, and pompanos: | | | | | | |
| *Caranx hippos*, crevalle jack..... | 6 | 5 | 11 | - | 8.1-36.0 | 24.2-31.8 |
| *Oligoplites saurus*, leatherjacket..... | - | 2 | 128 | 47 | 0-28.7 | 21.2-31.2 |
| *Selene vomer*, lookdown..... | 4 | - | - | - | 25.8-34.8 | 16.0-26.0 |
| *Trachinotus carolinus*, pompano..... | 457 | 1 | - | - | 25.8-37.8 | 15.2-31.0 |
| *Trachinotus falcatus*, permit..... | 8 | 3 | 1 | - | 12.9-36.9 | 21.3-27.0 |
| GERRIDAE - mojarras: | | | | | | |
| *Eucinostomus* sp., mojarra..... | 4 | 103 | 15 | - | 3.4-36.9 | 15.0-31.2 |
| POMADASYIDAE - grunts: | | | | | | |
| *Orthopristis chrysopterus*, pigfish..... | - | - | 31 | - | 0-17.6 | 24.8-31.2 |
| SCIAENIDAE - drums: | | | | | | |
| *Bairdiella chrysura*, silver perch..... | - | 1 | 262 | 3 | 0-27.5 | 16.7-31.2 |
| *Cynoscion nebulosus*, spotted seatrout... | - | - | 3 | - | 0-15.0 | 24.8-31.2 |
| *Cynoscion regalis*, weakfish..... | - | - | 1 | - | 9.8 | 30.8 |
| *Leiostomus xanthurus*, spot..... | 739 | 18,107 | 17,041 | 2,632 | 0-37.5 | 3.8-32.0 |
| *Menticirrhus americanus*, southern kingfish..... | 4 | - | - | - | 34.8-35.0 | 21.0-26.0 |
| *Menticirrhus littoralis*, gulf kingfish.. | 769 | - | - | - | 25.5-37.8 | 9.0-31.0 |
| *Menticirrhus saxatilis*, northern kingfish..... | 2 | - | 2 | - | 18.0-35.2 | 21.2-28.4 |

TABLE 1.--Marine fishes collected by station, with salinity and temperature ranges at capture, 1957-60 (continued)

| Species | Station | | | | Salinity | Temperature |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | °/oo | °C. |
| *Micropogon undulatus*, Atlantic croaker... | - | - | 2,674 | 362 | 0-22.3 | 13.9-31.8 |
| *Pogonias cromis*, black drum..... | 1 | - | - | - | 28.6 | 9.0 |
| *Sciaenops ocellata*, red drum..... | 1 | - | 171 | 4 | 0-32.6 | 7.5-26.8 |
| SPARIDAE - porgies: | | | | | | |
| *Lagodon rhomboides*, pinfish..... | 795 | 442 | 1,272 | 33 | 0-36.9 | 7.0-32.0 |
| KYPHOSIDAE - sea chubs: | | | | | | |
| *Kyphosus sectatrix*, Bermuda chub..... | 1 | - | 1 | - | 4.3-37.5 | 16.8-26.4 |
| EPHIPPIDAE - spadefishes: | | | | | | |
| *Chaetodipterus faber*, Atlantic spadefish. | - | - | 1 | - | 4.0 | 26.8 |
| SCOMBRIDAE - mackerels and tunas: | | | | | | |
| *Scomberomorus maculatus*, Spanish mackerel | 2 | - | - | 1 | 4.7-34.8 | 26.0-26.3 |
| GOBIIDAE - gobies: | | | | | | |
| *Gobiosoma bosci*, naked goby..... | - | - | 2 | 1 | 0-13.6 | 9.0-29.0 |
| TRIGLIDAE - searobins: | | | | | | |
| *Prionotus carolinus*, northern searobin.. | 20 | - | - | - | 26.6-35.8 | 16.0-27.7 |
| SPHYRAENIDAE - barracudas: | | | | | | |
| *Sphyraena barracuda*, great barracuda..... | 1 | - | - | - | 32.4 | 26.8 |
| MUGILIDAE - mullets: | | | | | | |
| *Mugil cephalus*, striped mullet..... | 650 | 2,989 | 4,909 | 2,256 | 0-37.5 | 6.0-32.0 |
| *Mugil curema*, white mullet..... | 78 | 452 | 456 | 208 | 0-37.8 | 11.8-32.0 |
| ANTHERINIDAE - silversides: | | | | | | |
| *Membras martinica*, rough silverside..... | 1,750 | 1,883 | 426 | 19 | 0-36.9 | 14.0-31.2 |
| *Menidia beryllina*, tidewater silverside.. | - | 3 | 1,812 | 3,678 | 0-22.3 | 2.9-32.0 |
| *Menidia menidia*, Atlantic silverside..... | 350 | 13,301 | 17,437 | 3,135 | 0-37.8 | 1.5-32.0 |
| BOTHIDAE - lefteye flounders: | | | | | | |
| *Etropus crossotus*, fringed flounder..... | - | 1 | - | - | 32.7 | 21.7 |
| *Paralichthys albigutta*, gulf flounder.... | 15 | 4 | - | - | 27.5-37.8 | 9.4-29.5 |
| *Paralichthys dentatus*, summer flounder... | 12 | 64 | 9 | - | 8.7-37.0 | 9.4-31.2 |
| *Paralichthys lethostigma*, southern flounder | 1 | 2 | 3 | 41 | 0-33.6 | 7.2-31.8 |
| *Paralichthys squamilentus*, broad flounder | 27 | - | - | - | 26.6-36.0 | 14.0-24.4 |
| *Scophthalmus aquosus*, windowpane..... | 36 | 1 | - | - | 25.8-36.0 | 9.4-25.6 |

TABLE 1.--Marine fishes collected by station, with salinity and temperature ranges at capture, 1957-60 (continued)

| Species | Station | | | | Salinity | Temperature |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | °/oo | °C. |
| SOLEIDAE - soles: | | | | | | |
| *Trinectes maculatus*, hogchoker..... | - | - | 5 | 22 | 0-15.0 | 11.0-31.8 |
| CYNOGLOSSIDAE - tonguefishes: | | | | | | |
| *Symphurus plagiusa*, blackcheek tonguefish | - | 1 | 9 | - | 3.4-30.0 | 16.8-29.0 |
| GOBIESOCIDAE - clingfishes: | | | | | | |
| *Gobiesox strumosus*, skilletfish..... | - | - | 3 | - | 4.3-12.1 | 16.8-29.0 |
| BALISTIDAE - triggerfishes and filefishes: | | | | | | |
| *Monacanthus hispidus*, planehead filefish. | 3 | 2 | - | - | 33.8-35.7 | 24.4-25.0 |
| TETRAODONTIDAE - puffers: | | | | | | |
| *Sphaeroides maculatus*, northern puffer... | 1 | - | - | - | 34.0 | 25.5 |

TABLE 2.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 1, Atlantic Beach, N. C., 1957-60 (5 samples in February and May; 6 in January, March, July-September, November and December; 7 in June and October; and 8 in April)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dasyatis sayi* | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | - | - | - | - | - | - | - | (460) | - | - | - | - |
| *Alosa aestivalis* | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | - | - | - | - | - | - | - | - | (44) | - | - | - |
| *Brevoortia tyrannus* | - | - | 36 | 27,906 | 328 | - | - | - | - | - | - | - |
| | - | - | (24-30) | (21-46) | (28-39) | - | - | - | - | - | - | - |
| *Anchoa hepsetus* | - | - | - | - | - | - | - | 85 | 3 | 1 | 5,001 | - |
| | - | - | - | - | - | - | - | (28-67) | (58-68) | (38) | (60-125) | - |
| *Anchoa mitchilli* | - | - | - | 2 | 24 | 4 | 44 | 73 | - | 7 | 1 | - |
| | - | - | - | (38-50) | (39-101) | (37) | (36-56) | (26-42) | - | (21-33) | (38) | - |
| *Anguilla rostrata* | 2 | 3 | - | - | - | - | - | - | - | - | 1 | 1 |
| | (64-68) | (60-70) | - | - | - | - | - | - | - | - | (60) | (64) |
| *Strongylura marina* | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (298) | - | - |
| *Hyporhamphus unifasciatus* | - | - | - | - | - | - | - | - | - | - | 1 | - |
| | - | - | - | - | - | - | - | - | - | - | (135) | - |
| *Fundulus majalis* | - | - | - | - | - | 2 | 2 | - | - | - | - | - |
| | - | - | - | - | - | (14-21) | (15-25) | - | - | - | - | - |
| *Syngnathus sp.* | 1 | - | - | 1 | - | - | - | 3 | 4 | - | 1 | - |
| | (63) | - | - | (112) | - | - | - | (96-119) | (37-80) | - | (119) | - |
| *Lutjanus blackfordi* | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | - | - | - | - | - | - | - | - | (19) | - | - | - |
| *Lutjanus griseus* | - | - | - | - | - | - | - | - | 2 | - | - | - |
| | - | - | - | - | - | - | - | - | (21-22) | - | - | - |
| *Pomatomus saltatrix* | - | - | - | - | 1 | - | 1 | - | - | 7 | 23 | - |
| | - | - | - | - | (46) | - | (100) | - | - | (65-79) | (40-55) | - |
| *Caranx hippos* | - | - | - | - | - | 2 | 2 | 2 | - | - | - | - |
| | - | - | - | - | - | (24-32) | (41-44) | (32-40) | - | - | - | - |
| *Sphyraena barracuda* | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | - | - | - | - | - | - | - | - | (24) | - | - | - |
| *Mugil cephalus* | 39 | 136 | 102 | 340 | 3 | 13 | 5 | - | - | - | - | 12 |
| | (24-28) | (20-32) | (14-34) | (20-41) | (28-44) | (22-168) | (27-178) | - | - | - | - | (19-29) |
| *Mugil curema* | - | - | - | 18 | 3 | 16 | 2 | 10 | 2 | 26 | - | 1 |
| | - | - | - | (22-34) | (24-28) | (25-30) | (28-31) | (97-139) | (22) | (19-144) | - | (108) |
| *Membras martinica* | - | - | - | 67 | 115 | 1 | 28 | 18 | 801 | 583 | 137 | - |
| | - | - | - | (70-100) | (62-100) | (47) | (21-59) | (24-63) | (17-81) | (21-115) | (32-100) | - |
| *Menidia menidia* | 19 | 7 | 138 | 62 | 94 | 13 | - | 4 | 1 | - | - | 12 |
| | (64-105) | (58-108) | (26-113) | (69-112) | (63-110) | (33-78) | - | (51-73) | (71) | - | - | (78-92) |
| *Paralichthys albigutta* | - | - | 4 | 8 | 1 | 2 | - | - | - | - | - | - |
| | - | - | (18-21) | (29-43) | (64) | (90-109) | - | - | - | - | - | - |
| *Paralichthys dentatus* | - | - | 4 | 7 | 1 | - | - | - | - | - | - | - |
| | - | - | (11-36) | (26-121) | (58) | - | - | - | - | - | - | - |
| *Paralichthys lethostigma* | 1 | - | - | - | - | - | - | - | - | - | - | - |
| | (14) | - | - | - | - | - | - | - | - | - | - | - |
| *Paralichthys squamilentus* | - | - | 3 | 23 | - | - | - | 1 | - | - | - | - |
| | - | - | (18-28) | (25-39) | - | - | - | (161) | - | - | - | - |
| *Scophthalmus aquosus* | 1 | - | 8 | 19 | 2 | - | - | - | - | - | 6 | - |
| | (160) | - | (19-148) | (44-223) | (39-42) | - | - | - | - | - | (110-165) | - |
| *Monacanthus hispidus* | - | - | - | - | - | - | - | 3 | - | - | - | - |
| | - | - | - | - | - | - | - | (19-24) | - | - | - | - |
| *Sphaeroides maculatus* | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | - | - | - | - | - | (14) | - | - | - | - | - | - |
| *Selene vomer* | - | - | - | - | - | 2 | - | - | - | - | 2 | - |
| | - | - | - | - | - | (35-41) | - | - | - | - | (42-55) | - |
| *Trachinotus carolinus* | - | - | - | 17 | 26 | 199 | 124 | 67 | 15 | 8 | 1 | - |
| | - | - | - | (14-20) | (13-51) | (14-116) | (18-142) | (20-172) | (20-121) | (13-155) | (39) | - |
| *Trachinotus falcatus* | - | - | - | - | - | 1 | - | - | 4 | 3 | - | - |
| | - | - | - | - | - | (26) | - | - | (14-35) | (14-17) | - | - |
| *Eucinostomus sp.* | - | - | - | - | - | - | - | - | 3 | 1 | - | - |
| | - | - | - | - | - | - | - | - | (10-11) | (18) | - | - |
| *Leiostomus xanthurus* | 37 | - | 118 | 528 | 51 | 3 | 1 | 1 | - | - | - | - |
| | (13-22) | - | (14-27) | (15-47) | (28-55) | (59-81) | (112) | (200) | - | - | - | - |
| *Menticirrhus americanus* | - | - | - | 1 | 1 | 2 | - | - | - | - | - | - |
| | - | - | - | (134) | (95) | (26) | - | - | - | - | - | - |

TABLE 2.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 1, Atlantic Beach, N. C., 1957-60 (5 samples in February and May; 6 in January, March, July-September, November and December; 7 in June and October; and 8 in April)--Continued

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Menticirrhus littoralis* | 1<br>(63) | -<br>- | 2<br>(78-88) | 10<br>(68-158) | 5<br>(74-190) | 25<br>(24-275) | 65<br>(15-160) | 240<br>(14-166) | 164<br>(10-147) | 150<br>(21-162) | 102<br>(29-166) | 5<br>(47-105) |
| *Menticirrhus saxatilis* | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 2<br>(92-167) | -<br>- | -<br>- | -<br>- | -<br>- |
| *Pogonias cromis*..... | 1<br>(232) | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- |
| *Sciaenops ocellata*..... | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 1<br>(415) | -<br>- | -<br>- |
| *Lagodon rhomboides*..... | 133<br>(14-17) | 2<br>(11-17) | 633<br>(11-110) | 9<br>(18-135) | -<br>- | -<br>- | -<br>- | 1<br>(16) | -<br>- | -<br>- | 11<br>(12-14) | 6<br>(14-18) |
| *Kyphosus sectatrix*..... | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 1<br>(106) | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- |
| *Scomberomorus maculatus* | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 2<br>(18-20) | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- |
| *Prionotus carolinus*..... | -<br>- | -<br>- | -<br>- | 1<br>(40) | -<br>- | -<br>- | -<br>- | 2<br>(114-123) | 17<br>(8-14) | -<br>- | -<br>- | -<br>- |

TABLE 3.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 2, Beaufort, N. C., 1957-60 (5 samples in February, March, and September; 6 in January, May-August, November, and December; 8 in October; and 9 in April)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Brevoortia tyrannus* .... | 2 | - | - | 5,917 | 90 | - | - | - | - | - | - | - |
| | (18-20) | - | - | (21-39) | (30-49) | - | - | - | - | - | - | - |
| *Opisthonema oglinum*.... | - | - | - | - | - | - | - | 14 | 153 | - | - | - |
| | - | - | - | - | - | - | - | (55-88) | (51-82) | - | - | - |
| *Anchoa hepsetus*..... | - | - | - | - | 2 | 69 | 1 | 23 | - | - | - | - |
| | - | - | - | - | (75-79) | (26-31) | (47) | (54-92) | - | - | - | - |
| *Anchoa mitchilli*..... | - | - | - | - | 60 | - | 1 | 117 | 666 | 18 | 4 | - |
| | - | - | - | - | (41-85) | - | (33) | (67-105) | (58-92) | (29-60) | (32-48) | - |
| *Synodus foetens*..... | - | - | - | - | - | 9 | 3 | - | 2 | 6 | - | - |
| | - | - | - | - | - | (57-114) | (83-130) | - | (93-375) | (58-188) | - | - |
| *Anguilla rostrata*..... | - | - | 3 | - | - | - | - | - | - | - | - | 1 |
| | - | - | (60-68) | - | - | - | - | - | - | - | - | (72) |
| *Conger oceanicus*..... | - | - | - | 4 | - | - | - | - | - | - | - | - |
| | - | - | - | (62-116) | - | - | - | - | - | - | - | - |
| *Strongylura acus*..... | - | - | - | - | - | 1 | - | - | 18 | 12 | 1 | - |
| | - | - | - | - | - | (289) | - | - | (260-444) | (319-412) | (296) | - |
| *Strongylura marina*..... | - | - | - | - | - | - | 5 | 4 | 22 | 140 | 2 | - |
| | - | - | - | - | - | - | (130-194) | (173-295) | (260-421) | (207-416) | (288-315) | - |
| *Hyporhamphus unifasciatus* | - | - | - | 15 | 7 | - | - | - | - | 76 | - | - |
| | - | - | - | (160-210) | (186-217) | - | - | - | - | (132-320) | - | - |
| *Cyprinodon variegatus*.. | 3 | 2 | - | 1 | - | - | - | - | - | - | - | 10 |
| | (41-47) | (25-35) | - | (40) | - | - | - | - | - | - | - | (36-49) |
| *Fundulus heteroclitus*.. | - | - | - | - | 3 | - | - | - | - | - | - | - |
| | - | - | - | - | (61-75) | - | - | - | - | - | - | - |
| *Fundulus majalis*..... | 18 | 1 | 32 | 99 | 185 | 227 | 759 | 151 | 31 | 425 | 30 | 131 |
| | (32-49) | (40) | (32-90) | (20-115) | (16-132) | (8-204) | (14-123) | (17-100 | (24-100) | (22-107) | (31-66) | (30-103) |
| *Pomatomus saltatrix*.... | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | - | - | - | - | - | - | (136) | - | - | - | - | - |
| *Caranx hippos*..... | - | - | - | - | - | 4 | - | 1 | - | - | - | - |
| | - | - | - | - | - | (32-45) | - | (27) | - | - | - | - |
| *Oligoplites saurus*..... | - | - | - | - | - | - | - | - | - | 2 | - | - |
| | - | - | - | - | - | - | - | - | - | (71-75) | - | - |
| *Trachinotus carolinus* .. | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | - | - | - | - | - | - | (83) | - | - | - | - | - |
| *Trachinotus falcatus*... | - | - | - | - | 1 | 1 | - | 1 | - | - | - | - |
| | - | - | - | - | (14) | (22) | - | (47) | - | - | - | - |
| *Eucinostomus sp*..... | - | - | - | - | - | - | 8 | 5 | 8 | 81 | 1 | - |
| | - | - | - | - | - | - | (18-38) | (12-58) | (75-112) | (33-112) | (76) | - |
| *Bairdiella chrysura*.... | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | - | - | - | - | (133) | - | - | - | - | - | - | - |
| *Leiostomus xanthurus*... | 352 | 192 | 873 | 10,585 | 3,263 | 1,970 | 488 | 119 | 49 | 205 | 9 | 2 |
| | (13-21) | (11-26) | (12-38) | (14-111) | (20-132) | (15-135) | (52-128) | (65-143) | (80-144) | (54-158) | (93-165) | (12-13) |
| *Lagodon rhomboides*..... | 56 | - | 3 | 51 | 57 | 108 | 38 | 44 | 27 | 43 | - | 15 |
| | (12-17) | - | (15-17) | (14-103) | (30-121) | (43-128) | (58-149) | (69-150) | (70-101) | (50-170) | - | (12-16) |
| *Mugil cephalus*..... | 6 | 23 | 352 | 1,791 | 112 | 145 | 24 | 233 | 17 | 91 | 178 | 17 |
| | (22-29) | (19-33) | (23-37) | (21-193) | (26-184) | (24-203) | (66-256) | (72-228) | (80-132) | (90-242) | (70-160) | (19-25) |
| *Mugil curema*..... | - | - | - | - | 5 | 130 | 96 | 38 | 23 | 152 | 8 | - |
| | - | - | - | - | (28-128) | (22-84) | (30-148) | (83-132) | (93-165) | (49-159) | (92-123) | - |
| *Membras martinica*..... | - | - | - | 24 | 9 | 79 | 1,115 | 406 | 36 | 201 | 13 | - |
| | - | - | - | (69-100) | (60-94) | (32-90) | (32-87) | (17-90) | (28-93) | (38-103) | (80-97) | - |
| *Menidia beryllina*..... | - | - | - | 3 | - | - | - | - | - | - | - | - |
| | - | - | - | (43-58) | - | - | - | - | - | - | - | - |
| *Menidia menidia*..... | 621 | 614 | 917 | 2,884 | 549 | 1,586 | 1,093 | 293 | 972 | 888 | 2,130 | 754 |
| | (47-122) | (57-112) | (42-110) | (40-114) | (23-123) | (25-121) | (18-105) | (38-101) | (51-90) | (43-97) | (40-116) | (39-108) |
| *Etropus crossotus*..... | - | - | - | 1 | - | - | - | - | - | - | - | - |
| | - | - | - | (75) | - | - | - | - | - | - | - | - |
| *Paralichthys albigutta* | - | - | - | - | 1 | - | - | 1 | 1 | 1 | - | - |
| | - | - | - | - | (185) | - | - | (80) | (168) | (112) | - | - |
| *Paralichthys dentatus*.. | - | - | 2 | 40 | 9 | 4 | 3 | - | 4 | - | 2 | - |
| | - | - | (30-33) | (19-164) | (36-115) | (44-126) | (62-84) | - | (68-179) | - | (165-180) | - |
| *Paralichthys lethostigma* | - | - | - | 1 | - | - | - | - | 1 | - | - | - |
| | - | - | - | (140) | - | - | - | - | (126) | - | - | - |
| *Scophthalmus aquosus*... | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (65) | - | - |
| *Symphurus plagiusa*..... | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (60) | - | - |
| *Monacanthus hispidus*... | - | - | - | 1 | 1 | - | - | - | - | - | - | - |
| | - | - | - | (23) | (17) | - | - | - | - | - | - | - |

TABLE 4.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 3, Neuse River, N. C., 1957-60 (4 samples in February; 6 in January, March, May-September, November, and December; and 8 in April and October)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Elops saurus* | - | - | - | 1 | - | - | 5 | 1 | - | - | - | - |
| | - | - | - | (29) | - | - | (104-139) | (200) | - | - | - | - |
| *Alosa aestivalis* | 29 | 9 | 6 | - | - | - | 1 | - | - | 2 | 25 | 5 |
| | (55-65) | (53-78) | (57-65) | - | - | - | (37) | - | - | (25-43) | (28-68) | (54-60) |
| *Alosa pseudoharengus* | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | - | - | - | - | - | - | (50) | - | - | - | - | - |
| *Alosa sapidissima* | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (74) | - | - |
| *Brevoortia tyrannus* | 3 | 1 | 2,190 | 5,815 | 2,576 | 47 | - | 8 | 835 | 5,176 | 36 | 1 |
| | (30-36) | (29) | (23-115) | (25-113) | (22-72) | (28-73) | - | (146-159) | (28-80) | (65-108) | (84-108) | (60) |
| *Opisthonema oglinum* | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | - | - | - | - | - | - | (98) | - | - | - | - | - |
| *Anchoa hepsetus* | - | - | - | - | - | 2 | 4 | 13 | 13 | 7 | - | - |
| | - | - | - | - | - | (23-25) | (25-62) | (48-73) | (50-95) | (50-70) | - | - |
| *Anchoa mitchilli* | 4 | 2 | 851 | 542 | 886 | 161 | 104 | 1,115 | 2,889 | 9,322 | 1,017 | 10 |
| | (26-40) | (45-53) | (28-74) | (28-75) | (22-70) | (20-60) | (19-65) | (18-59) | (15-80) | (19-90) | (26-68) | (44-64) |
| *Anguilla rostrata* | - | - | - | - | 3 | - | - | - | 1 | 1 | - | - |
| | - | - | - | - | (183-264) | - | - | - | (346) | (516) | - | - |
| *Strongylura marina* | - | - | - | - | 4 | 14 | 52 | 2 | 3 | - | - | - |
| | - | - | - | - | (63-67) | (73-195) | (138-322) | (140-160) | (114-290) | - | - | - |
| *Cyprinodon variegatus* | 1 | - | - | 1 | 3 | 1 | - | - | - | - | - | - |
| | (35) | - | - | (42) | (23-35) | (42) | - | - | - | - | - | - |
| *Fundulus heteroclitus* | - | - | - | 5 | 2 | 45 | 31 | - | - | - | - | - |
| | - | - | - | (35-85) | (52-78) | (23-85) | (40-86) | - | - | - | - | - |
| *Fundulus majalis* | - | - | - | 4 | 13 | 7 | 2 | 1 | - | 3 | - | - |
| | - | - | - | (70-84) | (71-106) | (80-100) | (26-96) | (38) | - | (35-45) | - | - |
| *Lucania parva* | - | - | - | - | - | 12 | - | - | - | - | - | - |
| | - | - | - | - | - | (26-32) | - | - | - | - | - | - |
| *Gambusia affinis* | - | - | - | 4 | - | - | - | - | - | 1 | 1 | - |
| | - | - | - | (22-28) | - | - | - | - | - | (38) | (19) | - |
| *Syngnathus* sp. | - | - | - | - | - | 4 | - | 1 | 10 | 1 | - | - |
| | - | - | - | - | - | (65-91) | - | (140) | (78-122) | (79) | - | - |
| *Pomatomus saltatrix* | - | - | 1 | - | 4 | 1 | 1 | - | - | - | - | - |
| | - | - | (120) | - | (66-77) | (86) | (123) | - | - | - | - | - |
| *Caranx hippos* | - | - | - | - | - | 2 | - | 2 | 5 | 2 | - | - |
| | - | - | - | - | - | (40-80) | - | (32-75) | (55-158) | (95-98) | - | - |
| *Oligoplites saurus* | - | - | - | - | - | - | 8 | 75 | 40 | 5 | - | - |
| | - | - | - | - | - | - | (22-51) | (20-93) | (28-88) | (40-75) | - | - |
| *Trachinotus falcatus* | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (80) | - | - |
| *Eucinostomus* sp. | - | - | - | - | - | - | 4 | 2 | 5 | 4 | - | - |
| | - | - | - | - | - | - | (30-36) | (38-70) | (58-109) | (71-86) | - | - |
| *Orthopristis chrysopterus* | - | - | - | - | - | 7 | 5 | 15 | 4 | - | - | - |
| | - | - | - | - | - | (40-74) | (58-97) | (75-132) | (86-116) | - | - | - |
| *Bairdiella chrysura* | - | - | 3 | 1 | - | - | 40 | 45 | 118 | 55 | - | - |
| | - | - | (95-119) | (122) | - | - | (41-80) | (58-103) | (60-165) | (76-150) | - | - |
| *Cynoscion nebulosus* | - | - | - | - | - | - | 2 | 1 | - | - | - | - |
| | - | - | - | - | - | - | (56-82) | (163) | - | - | - | - |
| *Cynoscion regalis* | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | - | - | - | - | - | - | (46) | - | - | - | - | - |
| *Leiostomus xanthurus* | 1 | 27 | 773 | 7,581 | 4,027 | 2,315 | 1,204 | 620 | 388 | 95 | 10 | - |
| | (26) | (16-48) | (17-140) | (14-140) | (18-150) | (33-130) | (39-163) | (39-135) | (39-128) | (40-143) | (93-107) | - |
| *Menticirrhus saxatilis* | - | - | - | - | - | - | - | - | - | 2 | - | - |
| | - | - | - | - | - | - | - | - | - | (70-90) | - | - |
| *Micropogon undulatus* | - | - | - | 1 | 1 | 317 | 838 | 1,038 | 331 | 148 | - | - |
| | - | - | - | (27) | (100) | (44-84) | (62-140) | (18-148) | (35-151) | (80-160) | - | - |
| *Sciaenops ocellata* | - | - | 1 | 3 | - | - | - | 5 | 7 | 113 | 40 | 2 |
| | - | - | (47) | (57-76) | - | - | - | (80-85) | (27-62) | (10-85) | (32-71) | (34-37) |
| *Lagodon rhomboides* | 17 | 1 | 11 | 477 | 210 | 229 | 117 | 56 | 91 | 40 | 23 | - |
| | (14-17) | (18) | (14-112) | (13-39) | (14-128) | (40-112) | (51-120) | (56-118) | (56-150) | (80-128) | (64-114) | - |
| *Kyphosus sectatrix* | - | - | - | - | - | - | - | - | - | 1 | - | - |
| | - | - | - | - | - | - | - | - | - | (105) | - | - |
| *Chaetodipterus faber* | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | - | - | - | - | - | - | - | - | (35) | - | - | - |

TABLE 4.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 3, Neuse River, N. C., 1957-60 (4 samples in February; 6, in January, March, May-September, November, and December; and 8 in April and October--Continued

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Gobiosoma bosci*..... | - | - | 1 | - | - | - | 1 | - | - | - | - | - |
| | - | - | (33) | - | - | - | (20) | - | - | - | - | - |
| *Mugil cephalus*..... | 111 | 24 | 724 | 2,209 | 818 | 159 | 320 | 225 | 208 | 18 | 93 | - |
| | (20-33) | (22-26) | (20-135) | (21-188) | (20-163) | (25-170) | (43-166) | (36-129) | (40-124) | (71-156) | (24-192) | - |
| *Mugil curema*..... | - | - | - | 3 | 2 | 208 | 90 | 87 | 55 | 10 | 1 | - |
| | - | - | - | (25-34) | (29) | (31-46) | (50-122) | (64-124) | (39-125) | (100-130) | (89) | - |
| *Membras martinica*..... | - | - | - | 1 | - | - | 199 | 210 | 7 | 9 | - | - |
| | - | - | - | (32) | - | - | (36-90) | (17-88) | (41-68) | (14-76) | - | - |
| *Menidia beryllina*..... | 16 | 15 | 11 | 118 | 548 | 832 | 84 | 12 | 65 | 63 | 30 | 18 |
| | (38-65) | (38-57 | (45-61) | (17-105) | (14-73) | (29-74) | (29-60) | (24-30) | (31-61) | (20-56) | (29-58) | (17-65) |
| *Menidia menidia*..... | 514 | 1,105 | 1,567 | 289 | 490 | 2,526 | 1,915 | 2,543 | 3,040 | 1,013 | 607 | 1,828 |
| | (64-108) | (40-112) | (48-115) | (19-118) | (18-110) | (16-108) | (17-90) | (18-98) | (28-90) | (38-94) | (28-110) | (40-112) |
| *Paralichthys dentatus*.. | - | - | - | 6 | - | - | 1 | 1 | - | 1 | - | - |
| | - | - | - | (26-48) | - | - | (150) | (128) | - | (163) | - | - |
| *Paralichthys lethostigma* | - | - | 1 | - | 2 | - | - | - | - | - | - | - |
| | - | - | (32) | - | (62-64) | - | - | - | - | - | - | - |
| *Trinectes maculatus*..... | - | - | - | - | - | 2 | 2 | - | - | - | 1 | - |
| | - | - | - | - | - | (73-78) | (77-78) | - | - | - | (85) | - |
| *Symphurus plagiusa*..... | - | - | - | - | - | - | - | - | 3 | 6 | - | - |
| | - | - | - | - | - | - | - | - | (105-120) | (92-120) | - | - |
| *Gobiesox strumosus*..... | - | - | - | 1 | - | 1 | - | - | - | 1 | - | - |
| | - | - | - | (43) | - | (20) | - | - | - | (47) | - | - |

TABLE 5.--Numbers and length ranges (mm. in parentheses) of marine fishes collected at station 4, Neuse River, N. C., 1957-60 (2 samples in February and March; 3 in January, May-August, November, and December; 4 in September and October; and 5 in April)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Elops saurus* | - | - | - | 1 | - | - | 1 | - | - | - | - | - |
| | - | - | - | (35) | - | - | (134) | - | - | - | - | - |
| *Alosa aestivalis* | 4 | - | - | 4 | - | - | 8 | 45 | 102 | 24 | 63 | - |
| | (48-50) | - | - | (60-69) | - | - | (32-45) | (24-41) | (28-37) | (30-38) | (42-58) | - |
| *Alosa sapidissima* | - | - | - | 4 | - | 28 | 10 | 2 | 3 | - | - | - |
| | - | - | - | (113-130) | - | (32-65) | (40-69) | (46-49) | (34-55) | - | - | - |
| *Brevoortia tyrannus* | - | - | 27 | 11,506 | 491 | - | 10,064 | - | 2,997 | - | - | - |
| | - | - | (22-38) | (19-48) | (28-48) | - | (50-125) | - | (52-134) | - | - | - |
| *Anchoa hepsetus* | - | - | - | - | - | - | 3 | 1 | - | - | - | - |
| | - | - | - | - | - | - | (61-62) | (68) | - | - | - | - |
| *Anchoa mitchilli* | - | 2 | 1 | 366 | 31 | 25 | 1,619 | 3,663 | 539 | 931 | 2 | - |
| | - | (28) | (38) | (24-58) | (38-51) | (13-79) | (16-72) | (19-36) | (15-40) | (24-56) | (39-45) | - |
| *Anguilla rostrata* | - | - | - | 1 | 2 | 2 | - | - | - | - | - | - |
| | - | - | - | (55) | (103-190) | (280-285) | - | - | - | - | - | - |
| *Strongylura marina* | - | - | - | - | - | 6 | 6 | 2 | 3 | 3 | - | - |
| | - | - | - | - | - | (62-415) | (65-148) | (174-195) | (238-279) | (200-371) | - | - |
| *Fundulus heteroclitus* | - | - | - | - | - | 41 | 19 | - | - | - | - | - |
| | - | - | - | - | - | (34-84) | (47-79) | - | - | - | - | - |
| *Gambusia affinis* | - | - | - | 1 | - | - | - | - | - | - | - | - |
| | - | - | - | (32) | - | - | - | - | - | - | - | - |
| *Roccus americanus* | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | - | - | - | - | - | (138) | - | - | - | - | - | - |
| *Oligoplites saurus* | - | - | - | - | - | - | 5 | 38 | 4 | - | - | - |
| | - | - | - | - | - | - | (28-35) | (35-85) | (66-92) | - | - | - |
| *Bairdiella chrysura* | - | - | - | - | - | - | 1 | - | 2 | - | - | - |
| | - | - | - | - | - | - | (46) | - | (91-100) | - | - | - |
| *Leiostomus xanthurus* | - | 3 | - | 1,596 | 192 | 107 | 166 | 174 | 190 | 196 | 8 | - |
| | - | (8-11) | - | (15-122) | (33-71) | (51-101) | (50-109) | (44-114) | (48-112) | (40-118) | (66-100) | - |
| *Micropogon undulatus* | - | - | - | 23 | 21 | 112 | 107 | 15 | 51 | 33 | - | - |
| | - | - | - | (28-150) | (42-122) | (53-122) | (61-118) | (74-135) | (70-138) | (100-150) | - | - |
| *Sciaenops ocellata* | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| | - | - | - | - | - | - | - | - | - | (35-45) | (25-39) | - |
| *Lagodon rhomboides* | - | - | - | 8 | 1 | 1 | 20 | 2 | - | 1 | - | - |
| | - | - | - | (16-24) | (38) | (79) | (58-80) | (74-93) | - | (120) | - | - |
| *Scomberomorus maculatus* | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | - | - | - | - | - | - | - | - | (131) | - | - | - |
| *Gobiosoma bosci* | - | - | - | 1 | - | - | - | - | - | - | - | - |
| | - | - | - | (37) | - | - | - | - | - | - | - | - |
| *Mugil cephalus* | 50 | 144 | 47 | 661 | 104 | 247 | 285 | 165 | 85 | 125 | 343 | - |
| | (103-122) | (18-156) | (21-33) | (22-158) | (36-112) | (40-195) | (30-226) | (60-135) | (78-141) | (60-190) | (86-163) | - |
| *Mugil curema* | - | - | - | - | - | 4 | 187 | 5 | 10 | 2 | - | - |
| | - | - | - | - | - | (42-45) | (38-172) | (63-95) | (92-127) | (105-118) | - | - |
| *Membras martinica* | - | - | - | 2 | 1 | 1 | 3 | 1 | 11 | - | - | - |
| | - | - | - | (75) | (75) | (28) | (57-90) | (89) | (37-54) | - | - | - |
| *Menidia beryllina* | 711 | 146 | 183 | 602 | 343 | 158 | 357 | 103 | 145 | 280 | 552 | 98 |
| | (16-75) | (21-70) | (20-90) | (21-87) | (19-98) | (14-80) | (31-83) | (22-70) | (25-68) | (20-69) | (16-75) | (22-72) |
| *Menidia menidia* | 9 | - | - | 1,809 | 1 | 37 | 130 | 649 | 89 | 334 | 43 | 34 |
| | (25-50) | - | - | (24-86) | (74) | (12-73) | (29-93) | (20-90) | (30-75) | (40-90) | (32-104) | (36-74) |
| *Paralichthys lethostigma* | - | 1 | 1 | 24 | 7 | 3 | - | 2 | - | 3 | - | - |
| | - | (100) | (88) | (28-69) | (34-186) | (61-190) | - | (58-68) | - | (70-155) | - | - |
| *Trinectes maculatus* | - | - | - | 3 | - | 7 | 1 | 1 | 3 | 7 | - | - |
| | - | - | - | (26-59) | - | (28-61) | (80) | (72) | (20-38) | (20-105) | - | - |

TABLE 6.--Ranges in water temperature (°C.) and salinity (°/oo) recorded at each station by month, vicinity of Beaufort, N. C., 1957-60

| | Jan. | Feb. | Mar. | Apr. | May | June |
|---|---|---|---|---|---|---|
| Station 1 | | | | | | |
| Temperature..... | 5.9-9.5 | 3.0-11.4 | 9.4-15.7 | 12.0-21.0 | 16.8-24.5 | 21.2-26.0 |
| Salinity..... | 25.8-33.6 | 26.0-33.8 | 32.0-36.0 | 24.9-35.9 | 28.4-35.7 | 29.6-37.8 |
| Station 2 | | | | | | |
| Temperature..... | 5.0-10.0 | 1.5-11.6 | 7.5-17.0 | 10.3-25.0 | 18.0-25.5 | 26.0-28.8 |
| Salinity..... | 24.2-30.8 | 22.0-33.4 | 27.0-36.5 | 22.3-35.0 | 25.2-35.7 | 27.6-36.6 |
| Station 3 | | | | | | |
| Temperature..... | 1.8-9.0 | 6.6-12.0 | 9.0-19.8 | 13.0-27.0 | 20.2-32.0 | 26.2-32.0 |
| Salinity..... | 0-7.8 | 2.0-7.1 | 1.9-8.0 | 0-8.7 | 0-11.1 | 0-20.4 |
| Station 4 | | | | | | |
| Temperature..... | 2.0-9.0 | 3.8-12.0 | 10.0-11.5 | 13.3-26.0 | 21.2-28.0 | 26.1-31.8 |
| Salinity | 0 | 0 | 0-1.2 | 0 | 0 | 0 |

| | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Station 1 | | | | | | |
| Temperature..... | 26.4-28.1 | 24.4-31.0 | 24.0-27.8 | 15.2-24.5 | 12.6-17.0 | 9.0-12.5 |
| Salinity..... | 31.8-37.5 | 33.6-35.8 | 31.9-35.7 | 28.8-35.3 | 25.8-33.8 | 25.5-34.2 |
| Station 2 | | | | | | |
| Temperature..... | 26.2-30.0 | 24.2-29.5 | 24.5-27.9 | 15.8-25.6 | 11.8-17.0 | 8.5-12.5 |
| Salinity..... | 31.3-37.0 | 33.4-36.9 | 31.9-34.7 | 28.7-33.0 | 24.4-32.8 | 22.5-34.1 |
| Station 3 | | | | | | |
| Temperature..... | 28.0-31.2 | 24.8-29.5 | 25.4-29.0 | 13.0-27.5 | 9.5-15.5 | 2.5-9.5 |
| Salinity..... | 7.4-17.6 | 0-13.6 | 3.4-22.3 | 4.3-19.0 | 4.6-17.6 | 1.5-11.2 |
| Station 4 | | | | | | |
| Temperature | 28.0-28.5 | 25.7-28.5 | 25.0-29.5 | 15.7-27.0 | 10.0-16.0 | 3.0-8.5 |
| Salinity | 0-5.0 | 0-4.7 | 0-4.7 | 0-5.6 | 0-4.8 | 0 |

TABLE 7.--Seasonal relative abundance in percent, by station, of major species collected, 1957-60

(Major species are those in which more than 100 were collected during survey. W (winter): Dec.-Feb.; Sp (spring): Mar.-May; S (summer): June-Aug.; F (fall): Sept.-Nov. Asterisk designates less than 0.6 percent)

| Species | Station 1 | | | | Station 2 | | | | Station 3 | | | | Station 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W | Sp | S | F | W | Sp | S | F | W | Sp | S | F | W | Sp | S | F |
| *Alosa aestivalis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | * | * | * | | * | * | * 3 |
| *Brevoortia tyrannus* | 0 | 92 | 0 | 0 | | * 21 | 0 | 0 | * | 32 | * | 23 | 0 | 66 | 54 | 42 |
| *Opisthonema oglinum* | 0 | 0 | 0 | 0 | 0 | 0 | * | 2 | 0 | 0 | * | 0 | 0 | 0 | 0 | 0 |
| *Anchoa hepsetus* | 0 | 0 | 8 | 70 | 0 | * | 1 | 0 | 0 | 0 | * | * | 0 | 0 | * | 0 |
| *Anchoa mitchilli* | 0 | * | 11 | * | 0 | * | 1 | 10 | * | 7 | 8 | 51 | * | 2 | 28 | 20 |
| *Strongylura marina* | 0 | 0 | 0 | * | 0 | 0 | * | 2 | 0 | * | * | * | 0 | 0 | * | * |
| *Fundulus heteroclitus* | 0 | 0 | 0 | 0 | 0 | * | 0 | 0 | 0 | * | * | 0 | 0 | 0 | * | 0 |
| *Fundulus majalis* | 0 | 0 | * | 0 | 5 | 1 | 12 | 7 | 0 | * | * | * | 0 | 0 | 0 | 0 |
| *Oligoplites saurus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | * | 0 | 0 | * | * | 0 | 0 | * | * |
| *Trachinotus carolinus* | 0 | * | 36 | * | 0 | 0 | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Eucinostomus* sp. | 0 | 0 | 0 | * | 0 | 0 | * | 1 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| *Bairdiella chrysura* | 0 | 0 | 0 | 0 | 0 | * | 0 | 0 | 0 | * | * | 1 | 0 | 0 | * | * |
| *Leistomus xanthurus* | 9 | 2 | * | 0 | 19 | 53 | 27 | 4 | 1 | 38 | 23 | 2 | | * 10 | 2 | 5 |
| *Menticirrhus littoralis* | 1 | * | 31 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Micropogon undulatus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | * | 12 | 2 | 0 | * | 1 | 1 |
| *Sciaenops ocellata* | 0 | 0 | 0 | * | 0 | 0 | 0 | 0 | * | * | * | 1 | 0 | 0 | 0 | * |
| *Lagodon rhomboides* | 34 | 2 | * | * | 2 | * | 2 | 1 | * | 2 | 2 | 0 | 0 | * | * | * |
| *Mugil cephalus* | 44 | 1 | 2 | 0 | 2 | 8 | 4 | 4 | 4 | 11 | 4 | 1 | 16 | 4 | 4 | 8 |
| *Mugil curema* | * | * | 3 | * | 0 | * | 3 | 3 | 0 | * | 2 | * | 0 | 0 | 1 | * |
| *Membras martinica* | 0 | * | 4 | 21 | 0 | * | 17 | 4 | 0 | * | 2 | * | 0 | * | * | * |
| *Menidia beryllina* | 0 | 0 | 0 | 0 | 0 | * | 0 | 0 | 1 | 2 | 5 | 1 | 79 | 6 | 3 | 14 |
| *Menidia menidia* | 9 | 1 | 2 | * | 70 | 16 | 32 | 59 | 92 | 7 | 39 | 18 | 4 | 10 | 4 | 6 |
| Other species | 2 | * | 3 | 1 | * | * | * | 2 | * | * | * | * | * | * | * | * |

MS # 1100



GPO 917249